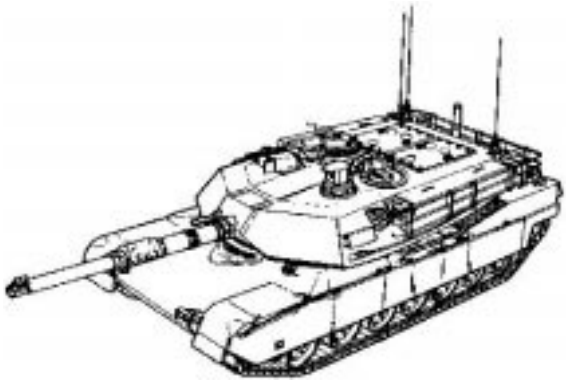
JOB PERFORMANCE AID HANDBOOK

TANK WEAPON GUNNERY SIMULATION SYSTEM (TWGSS)

FOR

TANK, COMBAT, FULL-TRACKED: 120-MM GUN, M1A2



LOCAL REPRODUCTION AUTHORIZED

This manual supersedes Job Performance Aid Handbook dated 15 May 1995.

HEADQUARTERS, DEPARTMENT OF THE ARMY

1 OCTOBER 1998

FOR INFORMATION ON FIRST AID, REFER TO FM 21-11.

WARNING

Vehicle master power switch, turret power switch, and utility jack on the RSM must be in OFF position before connecting or disconnecting cables and installing or removing system components. Failure to follow this warning may cause turret or main gun movement, resulting in injury or death to personnel.

WARNING

Ensure all cables and components are properly installed and secured. Improper installation can cause damage to equipment or injury to personnel.

WARNING

- **ALWAYS refer to the Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) operator's manual (see TD 17-6929-702) prior to installing, removing, loading, or firing simulator.**
- **DO NOT connect Improved Tank Gunfire Simulator (Hoffman Device) unless vehicle master power switch is in OFF position and simulator safety switch in OFF position, with key removed.**

WARNING

Tank MUST be equipped with LRF ELF during ALL training exercises unless equipped with the ESLRF. Failure to follow this warning may result in injury or blindness to personnel.

WARNING

Gun must be locked to turret roof and turret traverse lock must be engaged before installing or removing components/cables under main gun. Failure to follow this warning may result in injury or death to personnel.

WARNING

Transceiver unit has an eye-safety classification of 3A. During operation, DO NOT view the transceiver unit with an unaided eye for an extended period of time.

WARNING

The commander must ensure that the loader and other personnel remain a safe distance away from the main gun when not actively participating in TWGSS alignment procedures. Failure to follow this warning may result in injury or death to personnel.

WARNING

If a fire control malfunction is indicated on the CID, CITV, GCDP, or in the GPS, IMMEDIATELY set gun/turret drive switch to MANUAL position and vehicle master power switch to OFF position. Failure to follow this warning may cause turret or main gun movement, resulting in injury or death to personnel.

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FOR

TANK, COMBAT, FULL-TRACKED: 120-MM GUN, M1A2

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1-1. GENERAL.

a. This Job Performance Aid Handbook is intended for use by trained Tank Weapon Gunnery Simulation System (TWGSS) personnel. The handbook serves as a handy memory jogger to assist trained operators with required procedures.

b. Refer to TM 9-6920-709-12&P-1-2 for more information on TWGSS and refer to TM 9-6920-711-12&P-1 for more information on CGUN and TDRS.

1-2. EQUIPMENT DESCRIPTION.

a. **Purpose of TWGSS.** The TWGSS is a tank-mounted training device that aids the crew in gaining and improving proficiency in gunnery skills without the expenditure of live ammunition. Gunnery and tactical training can be conducted anywhere that eye-safe laser firing is permitted. TWGSS provides the crew with visual and sound effects which accurately simulate real firing conditions.

b. **Functional Configuration.** The TWGSS simulates the firing of the tank's main gun, the firing of the coaxially-mounted machine gun, and the effects of a target vehicle being hit. The TWGSS consists of three subsystems: firing system, target system, and Training Data Retrieval System (TDRS).

(1) **Firing System.** TWGSS simulates the firing ballistic characteristics of ammunition and the visual and sound effects of firing.

(2) **Target System.** The target system receives firing information from an attacking weapon, equipped with a laser training device, and notifies the crew of the effects of the attack. The attack could come from another TWGSS-equipped tank, a Precision Gunnery System (PGS)-equipped vehicle, or a Multiple Integrated Laser Engagement System (MILES)-equipped vehicle. An instructor using the control gun (CGUN) can also communicate with the TWGSS target system.

(3) **TDRS.** The TDRS is used to evaluate the effectiveness of the firing engagements whether in a tank weapon gunnery exercise or a tactical training environment. The TDRS provides real time analysis for each round fired and engagement under taken. For more information on TDRS, refer to TM 9-6920-711-12&P-1.

c. **Features and Capabilities.**

(1) Simulates tank firing and ammunition effect on targets.

(2) Provides full fire control interface to enable the tank crew to train using normal engagement techniques.

(3) Provides training capabilities utilizing Class 3A (conditionally eye safe) eye-safe laser.

(4) Interoperable and compatible with PGS, MILES, Laser Target Interface Device (LTID), Thru-Sight Video (TSV) System, and Improved Tank Gunfire Simulator (ITGS) (Hoffman Device).

NOTE

For detailed information on scaled gunnery or tracking training see TM 9-6920-709-12&P-1-2.

(5) Provides panel gunnery training, target tracking training, 1/10th and 1/2 scale target capability, and force-on-force training in a realistic environment with immediate feedback.

1-2. EQUIPMENT DESCRIPTION (Con't).

(6) Simulates the visual effects of the main gun and coaxially-mounted machine gun. These simulations include tracer, tracer burst on target, burst on ground, and obscuration images.

(7) Provides firing sound effects over tank intercom. These sound effects include:

(a) Main gunfire signature

(b) Coax gunfire signature

(c) Hit indication

(d) Ammunition loading

(e) System error indication

(8) Provides and stores continuously updated vehicular position, firing events, and time data information to be utilized during AAR in panel gunnery and force-on-force training.

1-3. EQUIPMENT LIMITATIONS.

a. To operate turret/gun systems in the manual/emergency mode during training exercises with TWGSS, turret power must be ON. Firing of the simulator can be performed using the manual firing device (blasting machine) and GAS.

b. The simulation of TBOS effect into commander's independent thermal viewer (CITV) is not performed.

1-4. OPERATION OF TWGSS WITH DEGRADED VEHICLE SYSTEM.

Operation of TWGSS with a degraded tank fire control system (FCS) is possible as TWGSS includes it's own sensors. Neither the gunner nor commander are required to enter any prompting data or adjustments to the simulator during simulated firing exercise. The simulator determines the projectile flight path from the gun axis and firing tables and is stabilized during time of flight by integral gyros. Examples of degraded FCS components are laser rangefinder inoperative, lead sensor failure, ballistic computer failure, and cant angle failure.

CHAPTER 2
OPERATING INSTRUCTIONS FOR TWGSS

Section I. PREPARATION FOR OPERATION

2-1. PRELIMINARY INSPECTION INSTRUCTIONS.

a. Perform *Before* operation Operator/Crew Preventive Maintenance Checks and Services (PMCS) (see TM 9-6920-709-12&P-1-2).

b. Inspect all tank connectors for dirt and damage prior to installing system components.

2-2. VEHICLE PREPARATION INSTRUCTIONS.

WARNING

Tank MUST be equipped with LRF ELF during ALL training exercises unless equipped with the ESLRF. Failure to follow this warning may result in injury or blindness to personnel.

a. Ensure LRF ELF is installed (see TM 9-2350-288-10-1).

NOTE

Improper boresighting of vehicle will result in poor training results.

b. Perform prepare-to-fire checks and boresighting procedures (see TM 9-2350-288-10-2).

2-2. VEHICLE PREPARATION INSTRUCTIONS (Con't).

c. Using manual turret and gun controls, position main gun over right #2 road wheel.

WARNING

Gun must be locked to turret roof and turret traverse lock must be engaged before installing or removing components/cable assemblies under main gun. Failure to follow this warning may result in injury or death to personnel.

d. Secure main gun to turret roof with elevation lock and position turret traverse lock in LOCKED position.

e. Remove main gun muzzle plug and inspect and clean interior of muzzle.

f. Inspect and clean gunner's auxiliary sight (GAS) optical port for dirt and debris.

g. Remove loader's periscope from loader's hatch and stow periscope in left turret storage box.

h. Remove fire control electronics unit (FCEU) protective guard from turret floor, using 9/16 in. socket.

i. Set coax boresight azimuth and elevation values to same as main gun boresight values.

j. Input the following computer correction factors using gunner's computer control and display panel (GCDP):

Ammunition	**Azimuth**	**Elevation**
HEAT M830	-0.25 Left	+0.37 Down
MPAT M830A1	+0.05 Right	-0.6 Up
SABOT M829A1	0.00	-0.45 Up
COAX M240	0.00	0.00

k. Input the following ballistic simulation data using GCDP:

(1) Set crosswind to manual and 0.

(2) Set ammunition temperature to 70° F.

(3) Set air temperature to 59° F.

(4) Set barometric pressure to 29.92 in. of mercury.

(5) Ensure pitch/roll is on ON position.

(6) Set CANT sensor selection to AUTO mode.

(7) Ensure lead is in ON position.

(8) Ensure hull/turret (HT) position sensor is in ON position.

(9) Confirm turret to hull alignment.

2-2. VEHICLE PREPARATION INSTRUCTIONS (Con't).

WARNING

Vehicle master power switch and turret power switch must be in OFF position before installing system components.

l. Place turret power switch and vehicle master power switch in OFF position.

m. Set gun/turret drive switch to MANUAL position.

n. Lock gun in elevation and turret in azimuth.

o. Install Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) (See TD 17-6920-702).

p. Install TSV System (see TD 9-6920-708-10, Vol. 2 of 2).

2-3. INSTALLATION OF EXTERIOR COMPONENTS.

NOTE

Adjustments to the tank's loading plan may be required to ensure that TWGSS components are properly installed.

a. **TU Installation.**

CAUTION

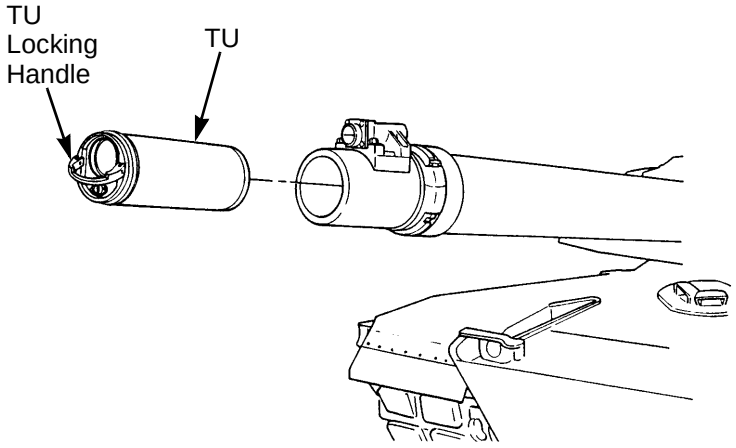
Ensure that TU is properly LOCKED into 120 mm adapter by checking that locking handle is in raised position. Failure to perform this check may result in the TU falling out of adapter.

(1) Lift locking handle to unlocked position.

(2) Position TU approximately 4-6 in. (10.16-15.24 cm) inside main gun.

(3) Using locking handle, rotate TU until laser lens is at 12 o'clock position.

(4) Push locking handle up to locked position.

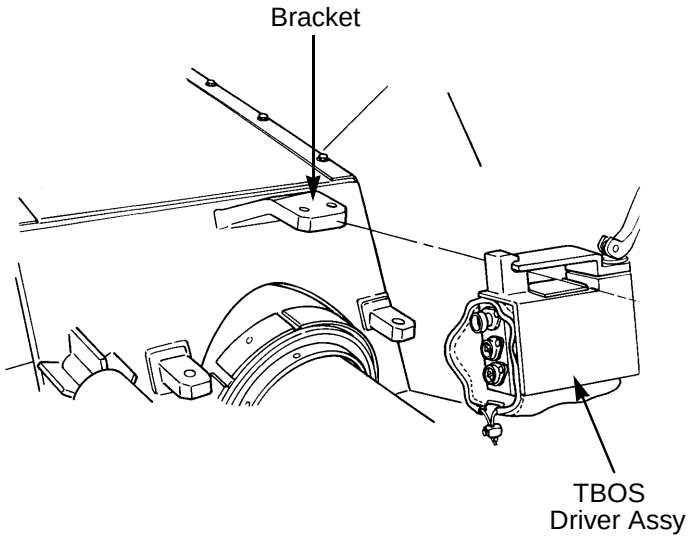


2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

b. **TBOS Driver Assembly Installation.**

(1) Position TBOS driver assembly on bracket.

(2) Pushing locking handle down to locked position.



2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

c. **TBOS GAS Installation.**

NOTE

TBOS GAS assembly is properly seated when mounting bracket is flush with main gun mantel lower armor plate.

(1) Position TBOS GAS assembly in GAS optical port.

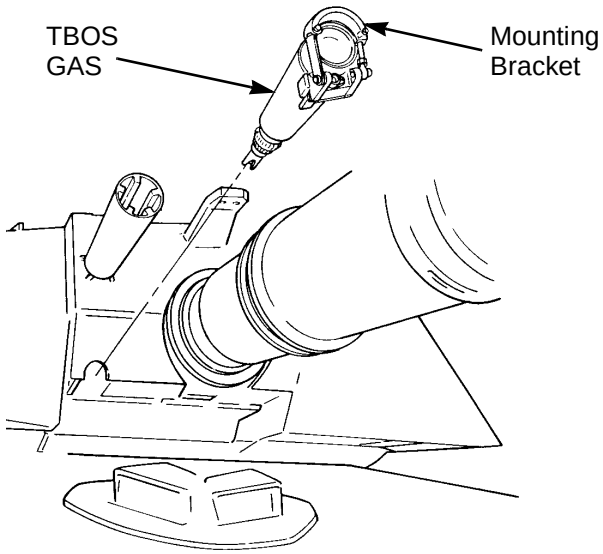
(2) Engage mounting bracket with roof of GAS optical port.

CAUTION

DO NOT overtighten locking nut. Overtightening will cause damage to TBOS GAS unit and reticle dot will not be properly aligned within GAS field of view.

(3) Tighten locking nut using 13 mm open end wrench from tank BII.

2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).



2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

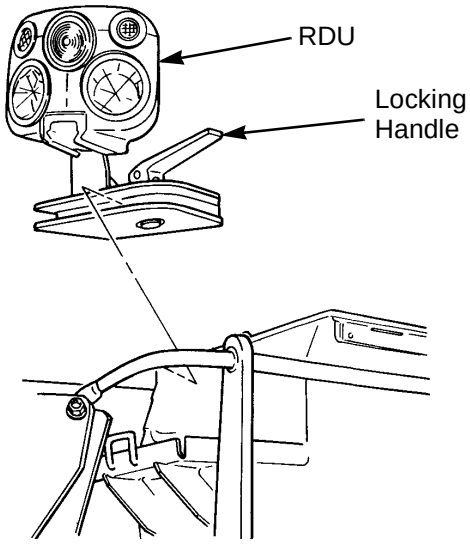
d. **RDU Assembly Installation (Right- and Left-Front).**

NOTE

Right- and left-front RDU assemblies are installed the same way. Left-front RDU assembly is illustrated. Perform this procedure for both retro detector assemblies.

(1) Lift locking handle and position RDU assembly on upper bustle rack railing forward of sponson box.

(2) Push locking handle down to locked position.



2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

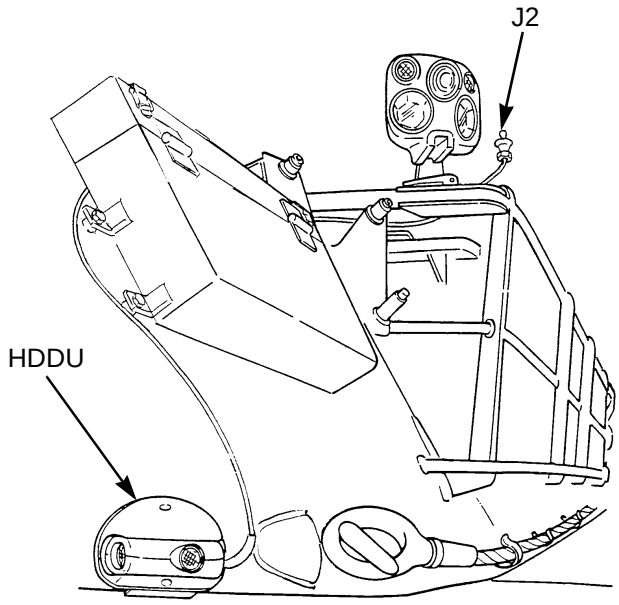
e. **HDDU Installation (Right- and Left-Front).**

NOTE

Right- and left-front HDDUs are installed the same way. Left-front HDDU is illustrated. Perform this procedure for both HDDUs.

(1) Position HDDU on lower edge of turret next to brush deflector.

(2) Route HDDU cable to RDU and connect cable connector J2. Secure HDDU cable with velcro straps.

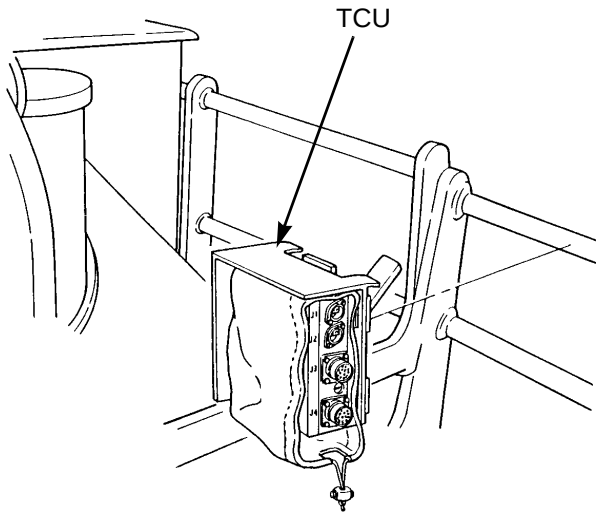


2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

f. **TCU Assembly Installation.**

(1) Position TCU assembly on inside of right-rear bustle rack railing with electrical connectors facing rear of tank.

(2) Push locking handle down to locked position.



2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

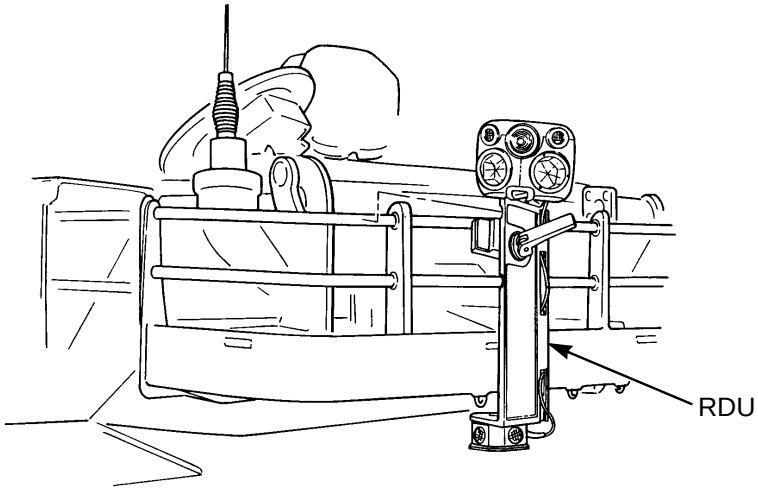
g. **RDU Assembly Installation (Right- and Left-Rear).**

NOTE

Right- and left-rear RDU assemblies are installed the same way. Left-rear RDU assembly is illustrated.

(1) Position RDU assembly on turret bustle rack on outside of outermost vertical bar.

(2) Push locking handle down to locked position.

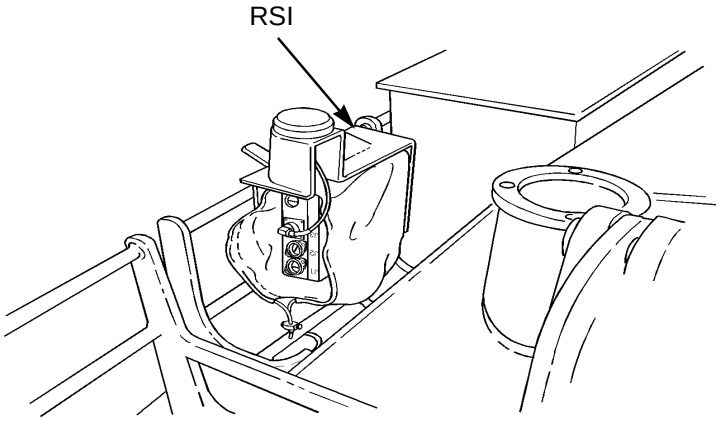


2-3. INSTALLATION OF EXTERIOR COMPONENTS (Con't).

h. **RSI Assembly Installation.**

(1) Position RSI assembly on inside of left-rear bustle rack railing flush with sponson box, with electrical connectors facing rear of tank.

(2) Push locking handle down to locked position.



2-4. INSTALLATION OF EXTERIOR CABLES.

a. **W1 Cable Installation.**

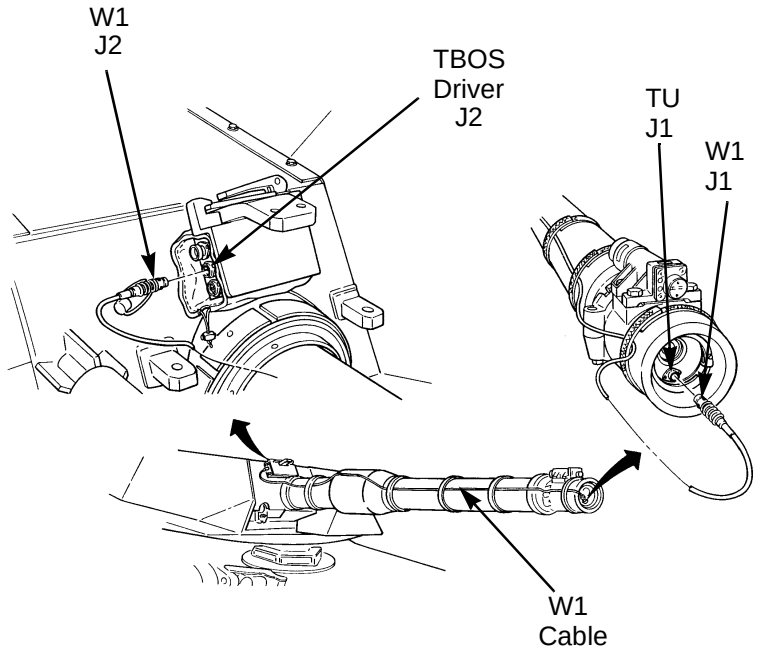
(1) Connect W1 connector J1 to TU connector J1.

CAUTION

Route and secure W1 cable rearward on upper right side (1 o'clock) of main gun. Damage to cable will result from engine exhaust heat when main gun is over back deck.

(2) Route W1 cable along upper right side of main gun and secure with evenly spaced velcro straps.

(3) Connect W1 connector J2 to TBOS driver unit connector J2.



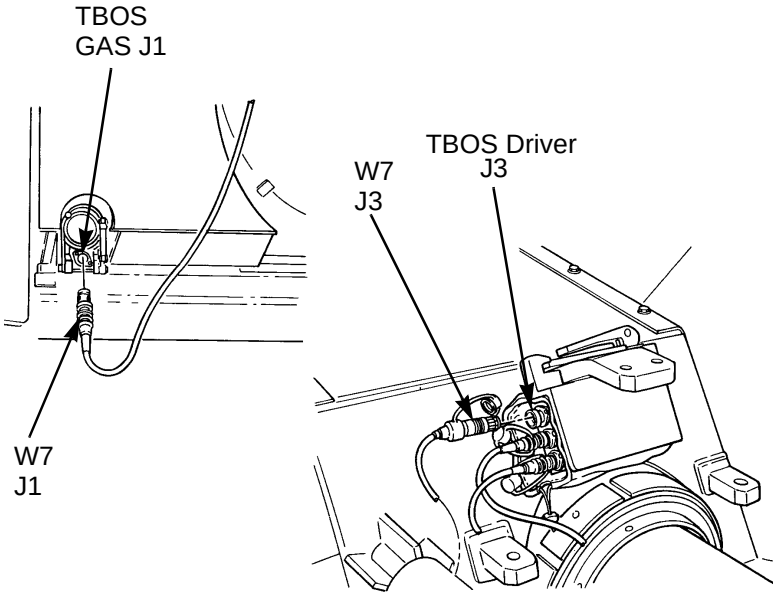
2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

b. **W7 Cable Installation.**

(1) Connect W7 connector J1 to TBOS GAS assembly connector J1.

(2) Route W7 cable on turret along right side of main gun and secure to turret with velcro straps.

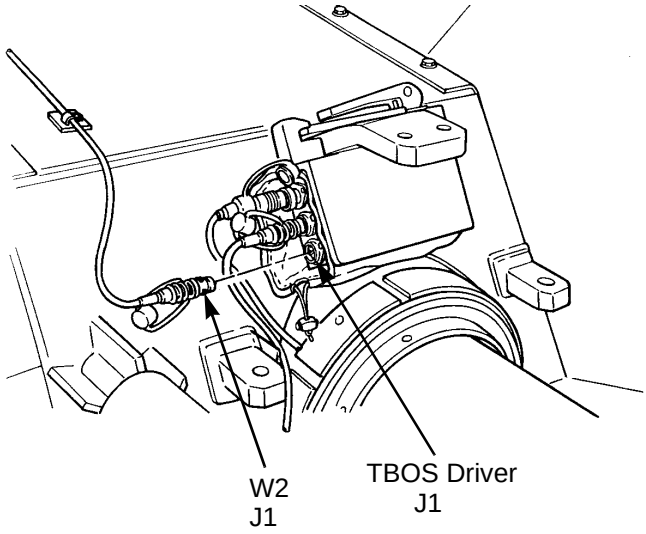
(3) Connect W7 connector J3 to TBOS driver unit connector J3.



2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

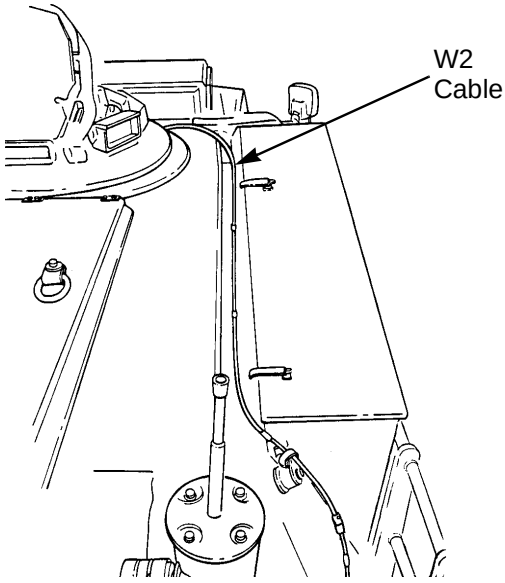
c. **W2 Cable Installation.**

(1) Connect W2 connector J1 to TBOS driver unit connector J1.

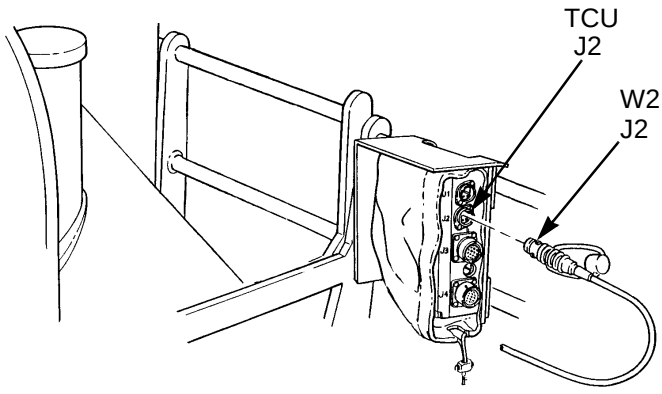


2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

(2) Route W2 cable over turret roof behind gunner's primary sight (GPS) to right of sponson box. Secure with magnetic attachment.



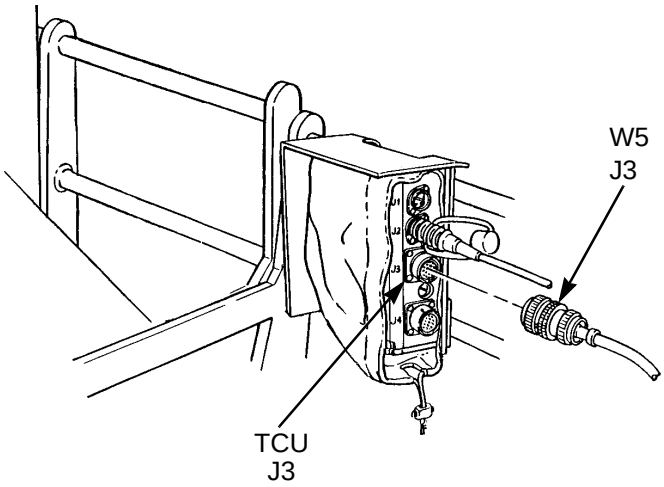
(3) Connect W2 connector J2 to TCU connector J2.



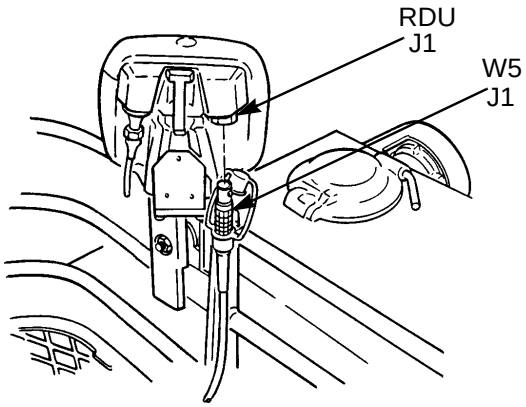
2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

d. **W5 Cable Installation.**

(1) Connect W5 connector J3 to TCU connector J3.

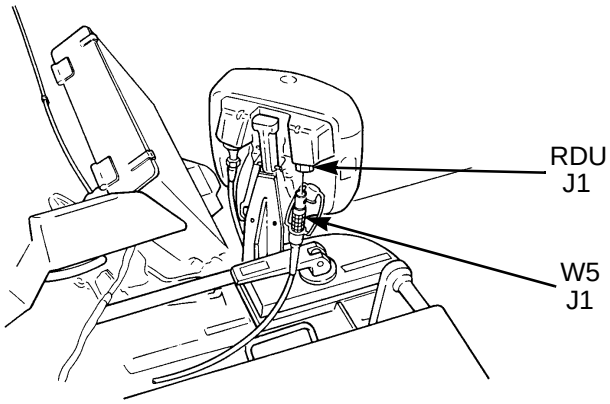


(2) Route W5 cable short lead to right-rear RDU assembly. Connect W5 connector J1 to right-rear RDU unit connector J1.

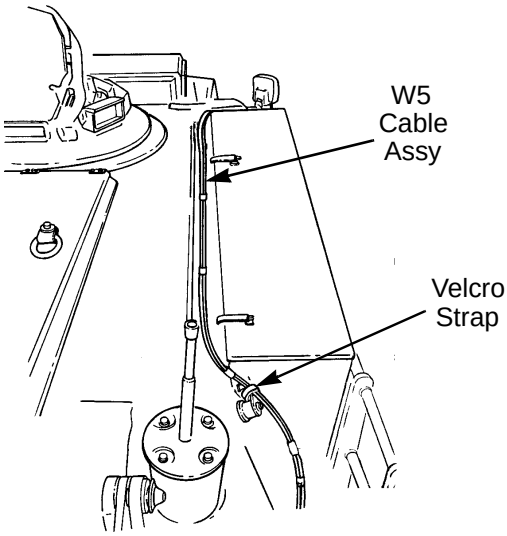


2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

(3) Route W5 cable long lead along sponson box to right-front RDU assembly. Connect W5 connector J1 to right-front RDU connector J1.

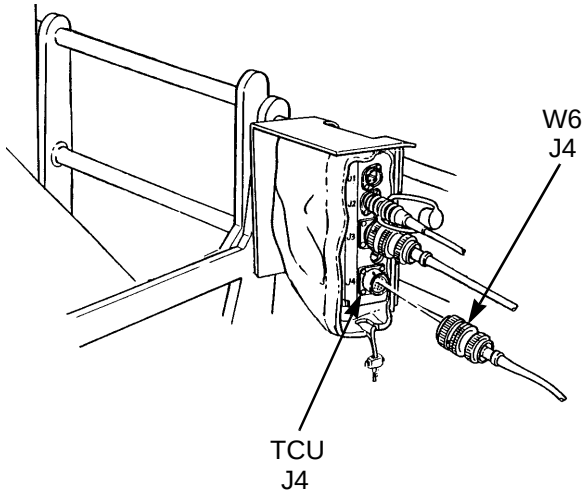


(4) Secure W5 cable along right side of turret roof with velcro straps.

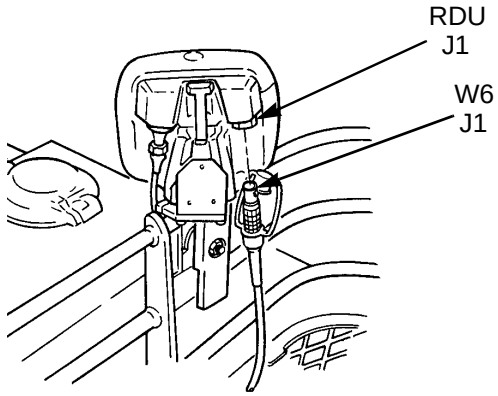


e. **W6 Cable Installation.**

(1) Connect W6 connector J4 to TCU connector J4.

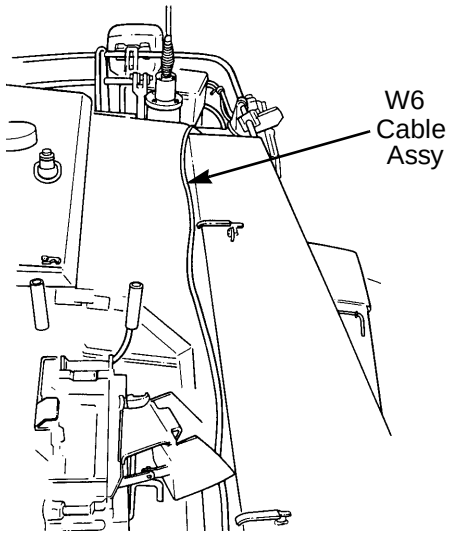


(2) Route W6 cable short lead along inside of turret bustle rack railing to left-rear RDU assembly. Connect W6 connector J1 to left-rear RDU connector J1.

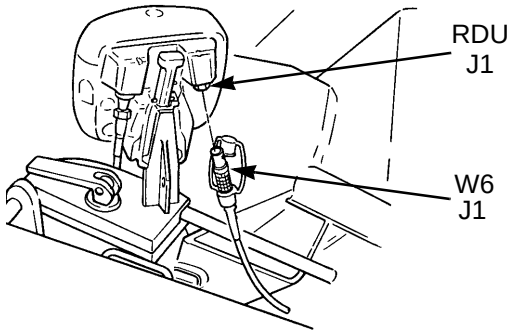


2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

(3) Route W6 cable long lead along inside of turret bustle rack railing and left sponson box rear railing to left-front RDU assembly.



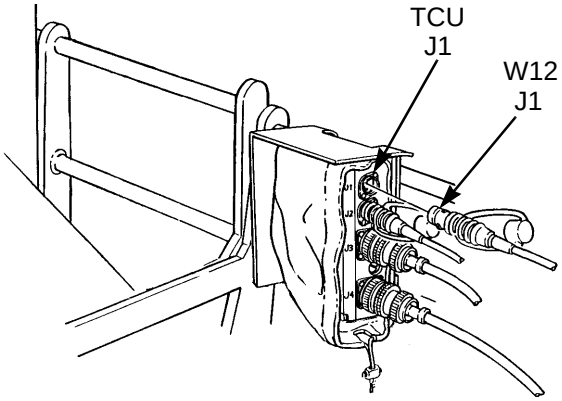
(4) Connect W6 connector J1 to left-front RDU connector J1.



2-4. INSTALLATION OF EXTERIOR CABLES (Con't).

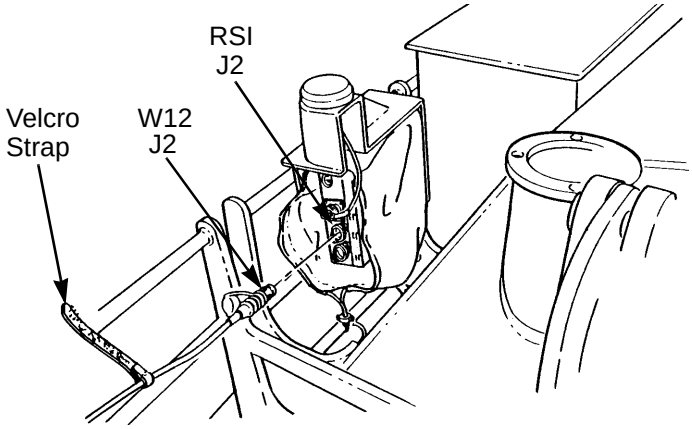
f. **W12 Cable Installation.**

(1) Connect W12 connector J1 to TCU connector J1.



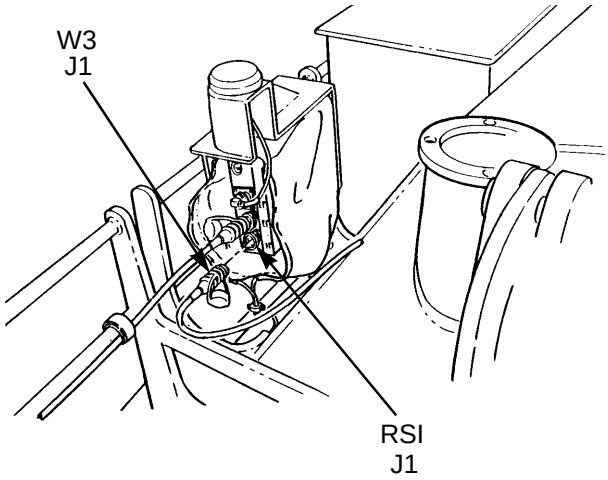
(2) Route W12 cable along inside of turret bustle rack railing, and connect W12 connector J2 to RSI unit connector J2.

(3) Secure W12 cable along bustle rack railing with velcro straps.



g. **W3 Cable Installation.**

(1) Connect W3 connector J1 to RSI unit connector J1.



NOTE

Allow slack when routing W3 cable through loader's hatch grommet. This will enable loader's hatch to open and close without straining W3 cable.

(2) Route W3 cable through loader's hatch grommet.

(3) Install loader's hatch grommet on loader's hatch with three retaining screws.

NOTE

Rotate periscope mount facing rearward. Attach cable magnets as close to hatch hinges as possible.

(4) Attach one cable magnet on outside of loader's hatch as close to hatch hinge as possible. Attach one cable magnet on inside of loader's hatch as close to hatch hinge as possible.

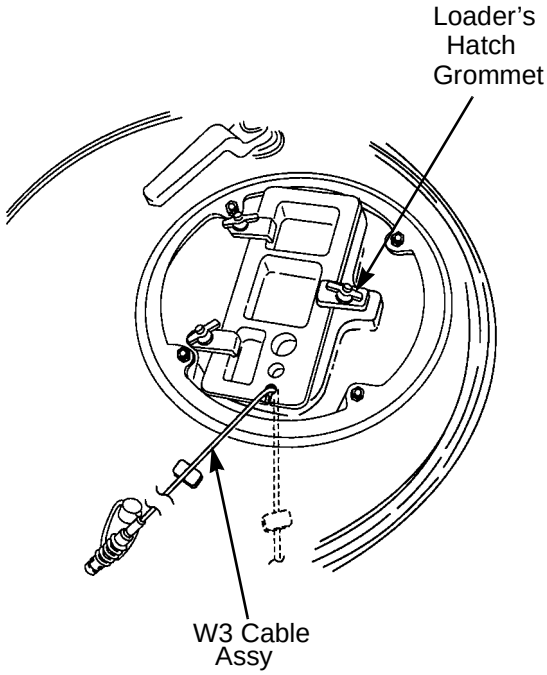
(5) Open loader's hatch to ensure that it can be operated without damaging W3 cable.

NOTE

DO NOT attach W3 cable to TBOS video mixer unit at this time.

(6) Secure W3 cable and W6 cable long lead in place along turret bustle rack railing and left sponson box rear railing with velcro straps.

2-4. INSTALLATION OF EXTERIOR CABLES (Con't).



2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES.

WARNING

- **Vehicle master power switch, turret power switch, and turret utility power switch must be in OFF position before installing interior components and cables.**
- **Gun must be locked to turret roof and turret traverse lock must be engaged before installing or removing components/cables under main gun.**
- **Ensure all cables and components are properly installed and secured. Improper installation can cause damage to equipment or injury to personnel.**

a. **Vehicle Interface Assembly Installation.**

CAUTION

DO NOT use cables to lower vehicle interface assembly into turret. Failure to follow this caution may result in damage to cables or cable connectors.

NOTE

- **VIU, TBOS video mixer unit, expansion unit, W4 cable and W13 cable are contained in the vehicle interface assembly.**
- **Before installing vehicle interface assembly, ensure that W4, W8, W9, W10, W13, W14, W15, and W16 cables are connected within vehicle interface assembly.**

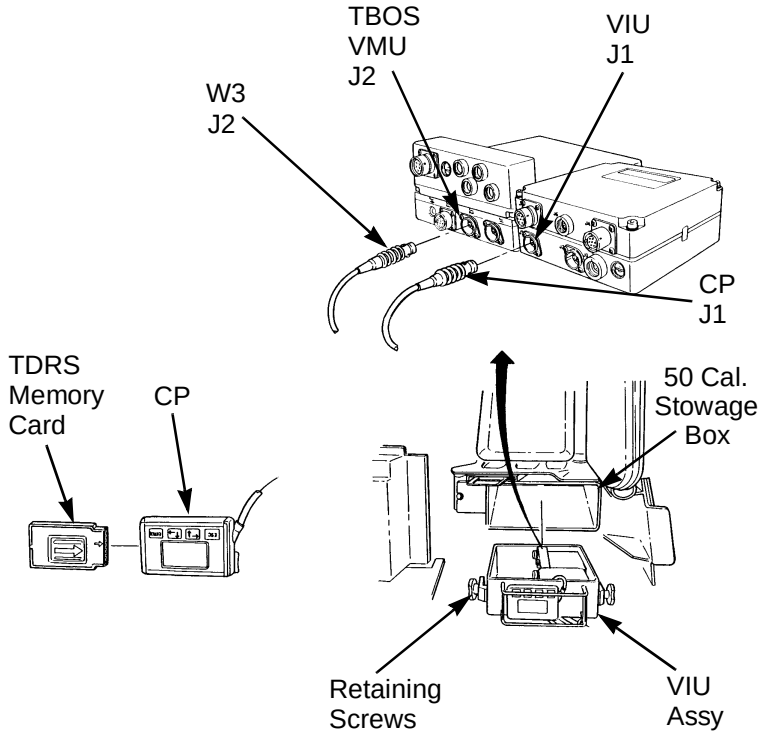
2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

(1) Connect W3 cable assembly connector J2 to TBOS video mixer unit connector J2.

(2) Connect control panel connector J1 to vehicle interface unit connector J1.

(3) Loosen two retaining screws and lower vehicle interface assembly into .50 cal. ammunition storage box until bracket mounting flange is resting on wall of .50 cal. ammunition storage box. Tighten two retaining screws.

(4) Install Training Data Retrieval System (TDRS) memory card in control panel until flush with end of control panel.



2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

b. **Interior Cables Installation.**

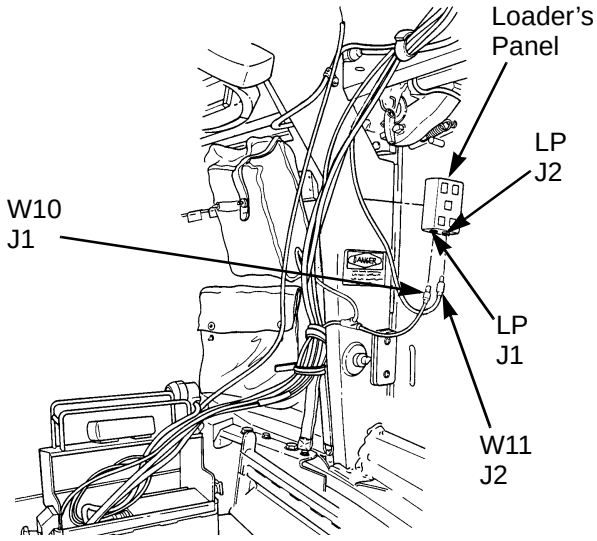
(1) Install loader's panel on center support beam between ammo storage door and facing loader.

NOTE

Ensure cables are secured to turret with velcro straps so as not to interfere with operation of ammo storage cases.

(2) Route cable bundle containing W10, W11, and W15 cables from vehicle interface assembly up turret support beam. Secure cable bundle to turret support beam with velcro straps.

(3) Connect W10 cable connector J1 to loader's panel connector J1.



(4) Connect W11 cable connector J2 to loader's panel connector J2.

(5) Route cable bundle containing W10, W11, and W15 cables from turret support beam over ammunition storage door at loader's position, and along left turret wall. Secure cables to existing turret cables with velcro straps.

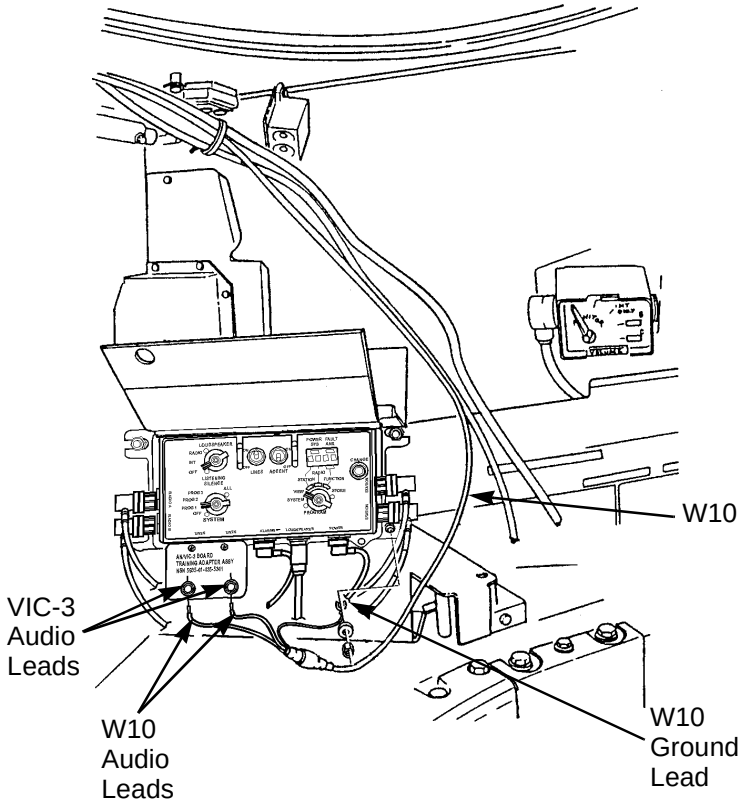
NOTE

When using the AN/VIC-3(V), install training adapter to amplifier terminals. Install audio input and audio ground to corresponding connection.

(6) Locate audio input and ground cable leads of W10 cable. Lift audio frequency amplifier cover and connect audio input and ground leads to training adapter. Close cover.

(7) Loosen VIC-3 MCS lower right mounting nut and position ground lead under washer. Tighten nut.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

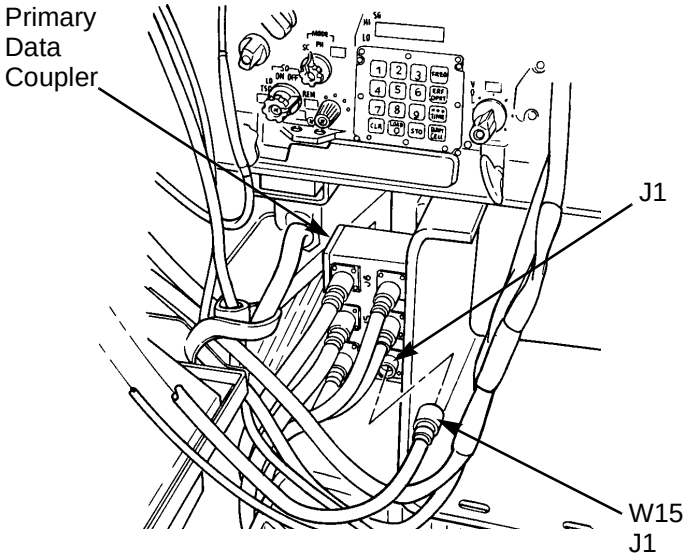


WARNING

- **Vehicle master power switch and turret power switch must be in OFF position before installing or removing interior components and cables.**
- **Gun must be locked to turret roof and turret traverse lock must be engaged before installing or removing interior components and cables under main gun.**

(8) Locate primary data coupler under turret radio rack. Remove protective cover from connector J1.

(9) Connect W15 cable connector J1 to primary data coupler connector J1.



(10) Locate fire control electronic unit (FCEU) under main gun on turret floor. Remove protective cover from FCEU connector TJ2.

(11) Connect W11 cable node connector TJ2 to FCEU connector TJ2.

NOTE

Turret cables connected to FCEU connectors J3 and J4 must be disconnected to gain access cable connector J12.

(12) Disconnect turret cables from FCEU connectors J3 and J4.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

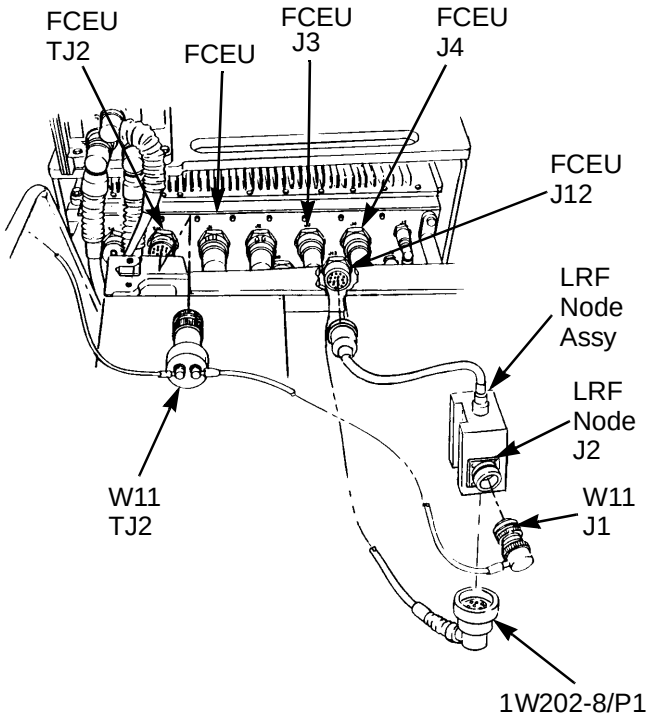
(13) Remove turret cable #1W202-8/P1 from FCEU connector J12.

(14) Connect turret cable #1W202-8/P1 to LRF node assembly connector J2.

(15) Connect W11 cable connector J1 to LRF node assembly connector J7.

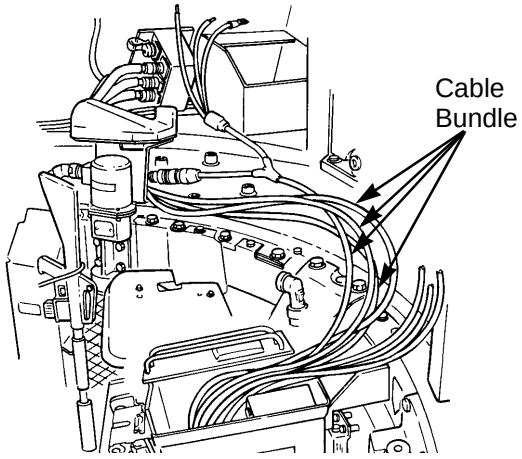
(16) Connect LRF node assembly to FCEU connector J12.

(17) Connect turret cables to FCEU connectors J3 and J4.



2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

(18) Route cable bundle containing W8, W9, W14, and W16 cables from vehicle interface assembly, to rear of commander's seat and along right turret wall.



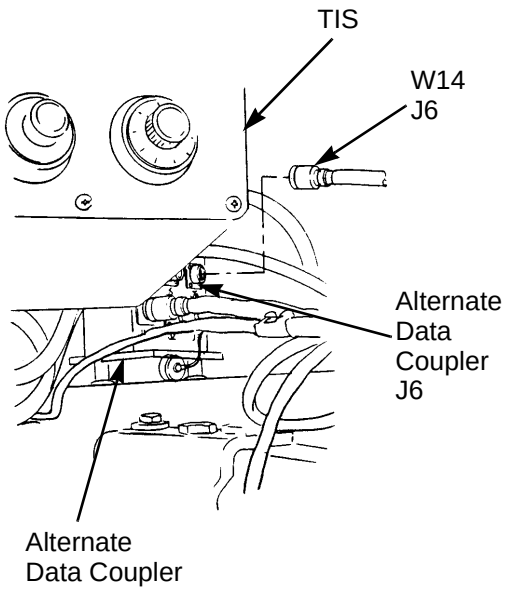
(19) Locate alternate data coupler to the right-rear of TIS control panel. Remove protective cover from connector J6.

(20) Connect W14 cable connector J6 to alternate data coupler connector J6.

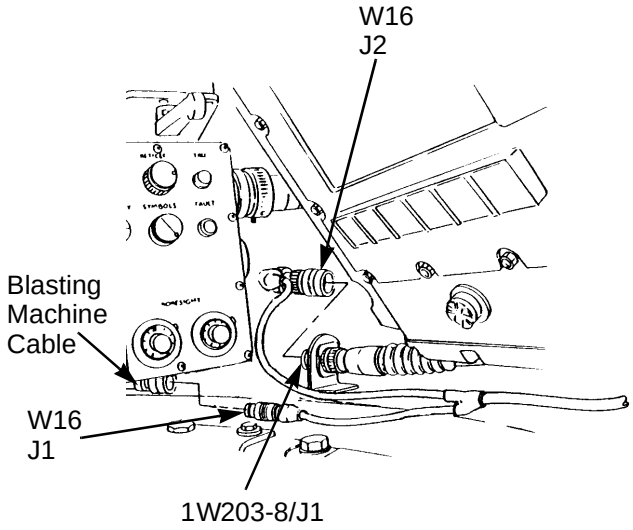
(21) Disconnect blasting machine cable #BMACH-P1 from turret cable #1W203-8/31 at cable support bracket to the right of TIS control panel.

(22) Connect W16 cable assembly connector J1 to blasting machine cable #BMACH-P1.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).



(23) Connect W16 cable assembly connector J2 to turret cable 1W203-8/31 connector mounted in cable support bracket.



(24) Disconnect thermal imaging system (TIS) cable connector J2 from TIS control panel connector J2.

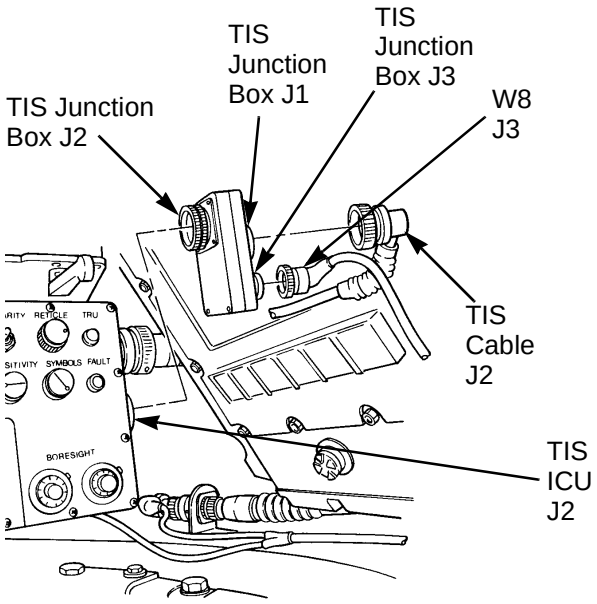
(25) Connect TIS cable connector J2 to TIS junction box connector J1.

(26) Connect W8 cable assembly connector J3 to TIS junction box connector J3.

CAUTION

- **Use care when positioning TIS junction box to prevent damage to pins of TIS control panel connector.**
- **When connecting TIS junction box to TIS control panel, handtighten connector. The use of tools will result in damage to TIS junction box.**

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).



(27) Connect TIS junction box connector J2 to TIS control panel connector J2.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

WARNING

- **ALWAYS refer to the Improved Tank Gunfire Simulator (ITGS) (Hoffman Device) operator's manual (see TD 17-6929-702) prior to installing, removing, loading, or firing simulator.**
- **DO NOT connect Improved Tank Gunfire Simulator (Hoffman Device) unless vehicle master power switch is in OFF position and simulator safety switch in OFF position, with key removed.**

CAUTION

DO NOT connect cable W9, Hoffman Power, to cable W16, Hoffman Trigger, when Hoffman Device is not used. Failure to follow this caution could cause equipment damage.

NOTE

Perform steps 28 through 30 only if Hoffman Device is installed on tank.

(28) Connect W9 cable connector HOFFMAN RTD to Hoffman Device cable connector HOFFMAN GROUND.

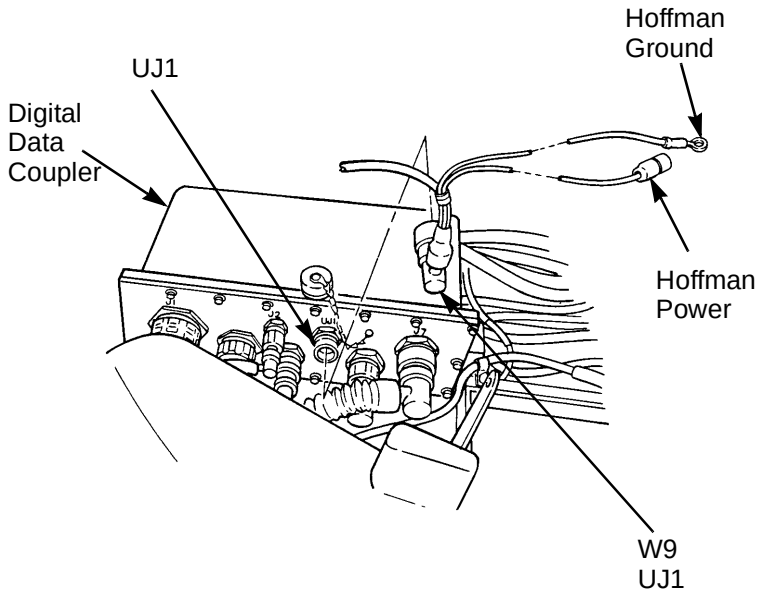
(29) Connect W9 cable connector HOFFMAN +28V to Hoffman Device cable connector HOFFMAN POWER.

(30) Connect W16 cable connector HOFFMAN TRIGGER to Hoffman Device cable connector HOFFMAN TRIGGER.

(31) Remove protective cover from utility jack connector UJ1 (58) of remote switching module.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

(32) Connect W9 cable assembly connector UJ1 to utility jack connector UJ1.



(33) Secure cable bundle in place with velcro straps.

2-5. INSTALLATION OF INTERIOR COMPONENTS AND CABLES (Con't).

WARNING

Ensure all cables and components are properly installed and secured. Improper installation can cause damage to equipment or injury to personnel.

(34) Ensure that all cable connectors are tight and that all cables are securely fastened.

(35) Install FCEU protective cover on turret floor, using 9/16 inch socket.

(36) Manually elevate and depress main gun to ensure that interior or exterior cables and other components of TWGSS do not become pinched or otherwise damaged.

(37) Manually traverse turret left and right to ensure that interior or exterior cables and other components of TWGSS do not become pinched or otherwise damaged .

(38) Check ammo storage doors to ensure that interior cables will not become pinched or otherwise damaged.

2-6. ALIGNMENT PROCEDURES.

NOTE

Alignment MUST be performed in strict accordance with instructions provided to ensure proper training results.

a. **Alignment Target Placement.**

(1) Position a target panel as close to 1200 meters away from the tank as possible. Target panel should be placed so that main gun is over the front of the tank when main gun is aligned with target panel.

(2) Mount a retro reflector unit on target panel.

b. **Vehicle Preparation and TWGSS Startup.**

(1) Set gun/turret drive switch in MANUAL position.

(2) Place vehicle master power switch in ON position.

(3) Place turret power switch in ON position.

WARNING

If a fire control malfunction is indicated on the CID, CITV, GCDP, or in the GPS, IMMEDIATELY set gun/turret drive switch to MANUAL position and vehicle master power switch to OFF position. Failure to follow this warning may cause turret or main gun movement, resulting in injury or death to personnel.

(4) Place turret utility power switch in ON position.

(5) Using GCDP, verify that fire control malfunction is not indicated. If a malfunction is indicated, perform operator/crew troubleshooting.

NOTE

- **All alignments must be performed in the order listed on the control panel menu screen. Alignment is performed selecting submenus from left to right.**
- **Informational pop-up screens, requiring the operator to adjust vehicle settings, appear during alignment. These vehicle settings must be performed in order for the operator to gain access to alignment menus.**
- **During TWGSS alignment, always enter 1200 m in FCS regardless of range to alignment RRU. Failure to follow this note will result in incorrect training results.**

c. **System Alignment.**

Select AL and press ENTER.

d. **Cant Alignment.**

NOTE

When CA is selected and ENTER is pressed to select an alignment submenu, a number of pop-up screens will appear on the control panel. Ensure that the information on the screens match vehicle setup. Press ENTER to continue after each setting.

(1) Select AL and press ENTER.

(2) Select CA on control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 3 through 5 need not be performed.

(3) Using GCDP, set cant sensor to automatic mode of operation.

(4) Press ENTER on the control panel.

(5) Select CA on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 6 and 7 need not be performed.

(6) Arm weapon.

(7) Press ENTER on the control panel.

NOTE

Cant alignment pop-up screen always appears.

(8) Select CA on the control panel and press ENTER.

(9) Press ENTER on the control panel to clear the screen and access cant alignment menu.

NOTE

The difference between the current cant angle of the transceiver unit and the cant angle of the tank is displayed on the control panel.

(10) Have loader lower transceiver unit locking handle and slowly rotate transceiver unit until values on control panel are less than ±0.5°.

CAUTION

Ensure that transceiver unit is properly LOCKED into mounting bracket within gun tube by checking that locking handle is in raised position. Failure to perform this check may result in transceiver unit falling out of gun tube and becoming damaged.

(11) Have loader raise locking handle to locked position.

(12) Press ESC on control panel.

e. **Laser Alignment.**

(1) Select AL and press ENTER.

(2) Select LA and press ENTER.

NOTE

- **When LA is selected and ENTER is pressed, a number of pop-up screens will appear on the control panel. Ensure that the information on he screens match vehicle setup. Press ENTER after each setting.**
- **If vehicle setting is correct, pop-up screens will not appear and steps 3 through 5 need not be performed.**

(3) Select EMERGENCY MODE.

(4) Press ENTER on control panel.

(5) Select LA on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 6 through 8 need not be performed.

(6) Place gun select switch in MAIN position.

(7) Press ENTER on the control panel.

(8) Select LA on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 9 through 12 need not be performed.

(9) Using GCDP, enter 1200 m into fire control system.

(10) Press and release palm switch in order to enter range into FCS.

(11) Press ENTER on the control panel.

(12) Select LA on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 13 through 15 need not be performed.

(13) Select boresight GPS.

(14) Press ENTER on the control panel.

(15) Press LA on the control panel and press ENTER.

NOTE

Magnification pop-up screen will always appear.

(16) Place GPS magnification lever to 10X position.

(17) Press ENTER on control panel.

NOTE

Aiming point pop-up screens will always appear.

(18) Using gunner's manual controls and while looking through GPS, lay aiming point on center of retro reflector unit mounted on target panel.

(19) Press ENTER on control panel. The actual alignment menu is presented.

(20) Press R to set all values to 0 and press ENTER.

NOTE

- **DO NOT adjust lay of main gun at any time when performing steps 21 and 22.**
- **Ensure that only one retro reflector unit is visible within field of view.**
- **The target hit deflection and range-to-target are displayed on the control panel display screen after pressing ENTER three times.**

(21) Select M and press ENTER. Press ENTER a minimum of three times.

NOTE

If SAVE is selected prior to three laser measurements, a pop-up screen appears. Repeat steps 20 and 21.

(22) Select S and press ENTER.

NOTE

If ESC is pressed prior to SAVE, a pop-up screen will appear. Repeat steps 20 through 22.

(23) Press ESC.

f. **TBOS GAS Alignment.**

(1) Select AL and press ENTER.

(2) Select a target with a dark background to allow for better observation of TBOS effects.

(3) Select GA and press ENTER. An aiming cross with an alignment dot appears in the GAS.

(4) Select R and press ENTER.

(5) Select AL and press ENTER. Only the aiming cross appears in the GAS.

NOTE

When alignment is selected, TBOS alignment steps are displayed on control panel.

(6) Rotate aiming cross until aligned with reticle, using up/down arrow buttons. Cross is properly positioned when it rests directly over the GAS boresight cross. Shorter vertical line in aiming cross MUST point downward.

(7) Press ENTER to save and continue alignment.

(8) Using up/down arrow buttons, adjust position of TBOS dot until dot is level with reticle boremark.

(9) Press ENTER to save and continue alignment.

(10) Using left/right arrow buttons, adjust position of TBOS dot until dot is level with reticle boremark.

(11) Press ENTER to save.

NOTE

After ENTER is pressed, the TBOS alignment reticle is displayed. If not properly aligned with sight reticle, repeat steps 4 through 11.

(12) Press ESC.

g. **TBOS GPS Day Alignment.**

(1) Select AL and press ENTER.

(2) Select a target with a dark background to allow for better observation of TBOS effects.

(3) Select GD and press ENTER.

NOTE

- **When GD is selected and ENTER is pressed, a number of pop-up screens will appear on the control panel. Ensure that the information on the screens match vehicle setup. Press ENTER after each setting.**
- **If vehicle setting is correct, pop-up screens will not appear and steps 4 through 6 need not be performed.**

(4) Select EMERGENCY MODE.

(5) Press ENTER on the control panel.

(6) Select GD on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 7 through 9 need not be performed.

(7) Set gun select switch to MAIN position.

(8) Press ENTER on the control panel.

(9) Select GD on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 10 through 13 need not be performed.

(10) Using GCDP, enter 1200 m into fire control system.

(11) Press and release palm switch in order to enter range into FCS.

(12) Press ENTER on the control panel.

(13) Select GD on the control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 14 through 16 need not be performed.

(14) Select boresight GPS.

(15) Press ENTER on the control panel.

(16) Select GD on the control panel and press ENTER.

(17) Select GPS FLT/CLEAR/SHTR switch to CLEAR position and TIS switch to STANDBY. Press ENTER on the control panel. Only the alignment dot appears in the GPS.

(18) Press ENTER on control panel.

(19) Select R and press ENTER.

(20) Select AL and press ENTER.

(21) Using up/down arrow buttons, adjust position of TBOS dot until dot is level with reticle aiming point.

NOTE

After ENTER is pressed, the TBOS alignment dot is displayed. If not properly aligned, repeat steps 19 through 21.

(22) Press ENTER to save and continue alignment.

h. **<u>TBOS GPS Thermal Alignment</u>.**

(1) Select AL and press ENTER.

(2) Select GT and press ENTER.

NOTE

- **When GT is selected and ENTER is pressed, a number of pop-up screens will appear on the control panel. Ensure that the information on the screens match vehicle setup. Press ENTER after each setting.**
- **If vehicle setting is correct, pop-up screens will not appear and steps 4 through 6 need not be performed.**

(3) Select EMERGENCY MODE.

(4) Press ENTER on control panel.

(5) Select GT on control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 7 through 9 need not be performed.

(6) Place gun select switch in MAIN position.

(7) Press ENTER on control panel.

(8) Select GT on control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 10 through 13 need not be performed.

(9) Using GCDP, enter 1200 m into fire control system.

(10) Press and release palm switch in order to enter range into FCS.

(11) Press ENTER on control panel.

(12) Select GT on control panel and press ENTER.

NOTE

If vehicle setting is correct, pop-up screens will not appear and steps 14 through 16 need not be performed.

(13) Select boresight GPS.

(14) Press ENTER on control panel.

(15) Select GT on control panel and press ENTER.

(16) Set GPS FLT/CLEAR/SHTR switch to SHUTTER position. Press ENTER on control panel.

(17) Move TIS thermal mode switch from STBY position to ON position. Press ENTER on control panel. Only the alignment dot appears in the GPS.

(18) Press ENTER on control panel.

(19) Select R and press ENTER.

(20) Select AL and press ENTER.

NOTE

When alignment is selected, TBOS alignment steps are displayed on the control panel.

(21) Using up/down arrow buttons, adjust position of TBOS dot until dot is level with reticle aiming point.

(22) Press ENTER to save and continue alignment.

(23) Using left/right arrow buttons, adjust position of TBOS dot onto reticle aiming point.

(24) Press ENTER to save.

NOTE

After ENTER is pressed, the TBOS alignment dot is displayed. If further adjustment is required, repeat steps 20 through 25.

(25) Press ESC.

i. **Alignment Verification.** After completing TWGSS alignment procedures, perform the following steps to verity that alignment is correct.

(1) Select and fire a simulated SABOT round at retro reflector used during alignment. Verify that TBOS effects and hit result are correct.

(2) Select and fire a simulated HEAT round at retro reflector used during alignment. Verify that TBOS effects and hit result are correct.

NOTE

Coax verification requires a target within 900 m of the tank.

(3) Select and fire a simulated COAX round at retro reflector used during alignment. Verify that TBOS effects and hit result are correct.

2-7. SETUP PROCEDURES.

a. **Backlight.**

(1) Select SU and press ENTER.

(2) Select BL and press left arrow button to turn backlight ON or right arrow button to turn backlight OFF. Press ENTER.

(3) Press ENTER.

b. **Contrast.**

(1) Select SU and press ENTER.

(2) Select CO and use left/right arrow buttons to change contrast. Press ENTER.

(3) Press ESC.

Section II. OPERATION OF TWGSS

2-8. GENERAL.

NOTE

For detailed information on scaled gunnery or tracking training see TM 9-6920-709-12&P-1-1.

a. This section describes operation of the Tank Weapon Gunnery Simulation System (TWGSS). The crew operates the tank weapons systems in their normal mode of operation and crew input to TWGSS is not required except for the loader. The loader simulates main gun loading by pressing a pushbutton on the loader's panel which selects the type of ammunition as directed by tank commander.

b. The TWGSS training exercise is set up by the instructor using the Training Data Retrieval System (TDRS) computer unit. The instructor sets the ammunition allowance and obscuration burn time. Refer to TM 9-6920-711-12&P-1.

2-8. GENERAL (Con't).

c. Target engagement feedback is provided by the TWGSS in the form of audio tones and visual effects. When simulating firing on a target vehicle, the appropriate sound signature will accompany the loading and firing of the weapon. In the sight, the gunner can see the visual effects of firing obscuration, tracers, burst on target, and burst on ground. Listed below are the audio and visual effects provided during operation of the TWGSS.

(1) Audio tones and control panel messages indicate to target vehicles that they are under fire or destroyed.

(2) Strobe lights indicate to firing vehicle that the target is hit or destroyed.

2-9. CREW OPERATIONS.

NOTE

- **During an upload sequence, TWGSS transfers a full ready rack (turret) or remaining ammunition in semi-ready rack (hull).**
- **The remaining time of upload appears on control panel display screen.**
- **When ammunition has been uploaded, COMPLETED will appear on control panel display screen.**
- **Upload time is programmed on TDRS memory card by training controller.**
- **If ESC is pressed during an upload sequence, process is stopped and ammunition is not transferred.**

a. **Ammunition.** The crew can monitor remaining ammunition during an exercise using the control panel.

(1) Select SI and press ENTER.

(2) Select RM and press ENTER.

(3) To monitor main gun ammunition, select MW.

(4) To upload main gun ammunition, press ENTER.

(5) Select main gun ammunition to be uploaded using up/down arrow buttons.

(6) Press ENTER to start upload.

(7) To monitor coax ammunition, select CO.

(8) Press ENTER to start upload.

b. **Laser Rangefinder (LRF).** The crew can select either TWGSS rangefinder or tank rangefinder.

WARNING

Tank MUST be equipped with LRF ELF during ALL training exercises unless equipped with the ESLRF. Failure to follow this warning may result in injury or blindness to personnel.

NOTE

- **When conducting 1/10th or 1/2 scale training, TWGSS LRF must be selected.**
- **If vehicle master power switch has been set to OFF position and then returned to ON position, TWGSS LRF will automatically be selected.**

(1) Select LF and press ENTER.

(2) Using up/down arrows buttons, select LRF to be used and press ENTER.

2-10. RESULTS.

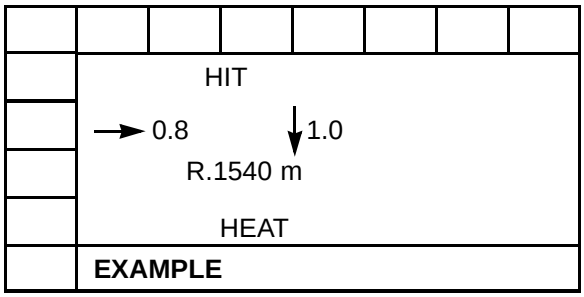
a. **General.** Results of the training exercise can be displayed numerically or graphically, or the result presentation can be turned off.

b. **Numerical Presentation.**

(1) Numerical presentation allows for immediate feedback and result presentation of hit coordinates and type of ammunition.

(2) Results are presented in a pop-up screen on the control panel.

(3) A pop-up screen appears until a new result is displayed or a control panel button is pressed.



c. **Graphics Display (GD).**

(1) Graphic presentation allows for immediate feedback and is used for panel gunnery training exercises where display of the hit in relation to the target outline is preferred over actual hit coordinates.

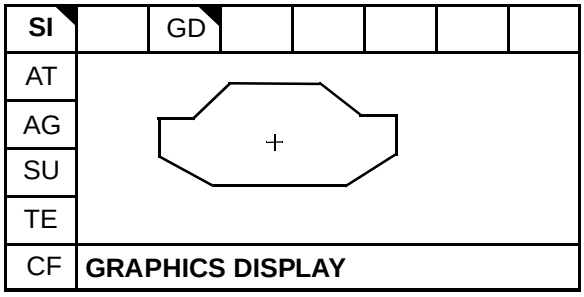
NOTE

This screen identifies the target silhouette and hit position (x) in relation to target center of mass (+).

(2) Select SI and press ENTER.

2-10. RESULTS (Con't).

(3) To view results graphically, select GD and press ENTER. Graphics display shows the target template of ammo fired.



(4) Press ESC to exit graphics display.

d. **Result Presentation Off.** For force-on-force exercises, the instructor can program the TDRS memory card to store the training results without displaying them on the control panel.

2-11. DESCRIPTION OF HIT RESULT.

a. TWGSS provides results for firing vehicles and target vehicles.

b. A fire result provides information in four areas:

(1) Engagement evaluation.

(a) **HIT.** A HIT presentation indicates that the simulated round has hit the target. TWGSS assumes the target to be either a T80 Front (NATO standard size) for main gun rounds or a kneeling soldier for coax rounds. If the control panel indicates HIT, MILES codes are transmitted to enable the laser target interface device (LTID) to indicate.

2-11. DESCRIPTION OF HIT RESULT (Con't).

(b) **GROUND HIT.** A GROUND HIT presentation indicates that the ammunition has fallen short or long. The range for the actual ground impact is presented.

(c) **MAX RANGE.** If the control panel indicates MAX RANGE, the ammunition has passed above the target and reached the maximum simulated range of the ammunition.

(2) Elevation and azimuth impact point on target in relation to center of mass.

(3) Actual range, in meters, to target.

(4) Type of ammunition fired.

2-12. TARGET RESULT PRESENTATION.

A target result provides information in three areas:

a. Effect of incoming round on vehicle (target system evaluation).

(1) **NEAR MISS.** A projectile has passed close to the vehicle. The crew can continue to fight.

(2) **HIT.** The vehicle is hit, but not damaged. The crew can continue to fight.

(3) **MOBILITY KILL.** The vehicle is damaged and immobilized by a hit. If the control panel indicates MOBILITY KILL, the crew must stop tank within 30 seconds or the vehicle will be permanently killed. When a vehicle has suffered a mobility kill, the crew can continue to engage targets with their weapons from a standstill position.

(4) **WEAPON KILL.** The vehicle is hit and the weapon system is damaged. The crew can move the vehicle, but cannot fire any weapons.

2-12. TARGET RESULT PRESENTATION (Con't).

(5) **KILL.** The vehicle is hit and has sustained a catastrophic kill. The crew cannot move the vehicle or fire any weapons.

b. Aspect angle of incoming round. Aspect angle is divided into 12 sectors according to the clock.

c. Elevation and azimuth impact point on vehicle in relation to center of mass.

2-13. AUDIO INDICATIONS.

a. **General.** The system uses sound to indicate to the crew that different events have taken place. The audio indications can be divided into firing system, target system, and system error audio indications.

b. **Audio Indications of Firing System.** During loading and firing of ammunition, the following audio indications are heard through the tank intercom:

(1) Opening/closing of ammunition door. This occurs when the loader uses the loader's panel to load/unload ammunition.

(2) Closing of breech block. This indicates that the round is chambered and ready to be fired.

NOTE

If the gun is left loaded and armed for more than 30 minutes, TWGSS will go into a power down mode. Loader must SAFE then ARM the gun prior to firing.

(3) Main gun fire and ammunition case base ejection from breech. This indicates a successful firing of a round.

(4) Coax fire.

c. **Audio Indications of Target System.** When a TWGSS system is fired upon from other simulator equipped vehicles, the tank intercom indicates that the vehicle is being fired upon.

NOTE

On newer systems, voice messages will follow audio "beeps".

(1) **NEAR MISS.** If the vehicle had a near miss, two "beeps" or two "beeps" followed by "Near Miss, Direct Fire" are transmitted on the vehicle intercom.

(2) **HIT (NO KILL).** If the vehicle is hit, but not killed, 4-6 "beeps" or 4-6 "beeps" followed by "Hit, Direct Fire" are transmitted on the vehicle intercom.

NOTE

If panel gunnery training is used, the target system is auto-activated after 5 seconds. The audio indication stops and the system is operational. The kill is stored on the TDRS memory card together with auto-activation for After Action Review (AAR).

(3) **HIT (MOBILITY KILL).** If the vehicle is hit and the target computer has determined that a mobility kill has occurred, 4-6 "beeps" or 4-6 "beeps" followed by "Hit Mobility" are transmitted on the vehicle intercom. In addition, the control panel informs commander of action to take.

(4) **HIT (WEAPON KILL).** If the vehicle is hit and the target computer has determined that a weapon kill has occurred, 4-6 "beeps" or 4-6 "beeps" followed by "Hit Firepower" are transmitted on the vehicle intercom. In addition, the control panel informs commander of action to take.

(5) **KILL.** A continuous tone for 30 seconds or "Vehicle Kill" followed by a continuous tone for 30 seconds is transmitted on the vehicle intercom.

d. **System Errors.** Audio indication is also provided for system errors.

2-14. VISUAL INDICATIONS OF SYSTEM.

The target system indicates the effect of an engagement with the RDU strobe lights. The following visual indications are given by the target system:

a. **NEAR MISS.** If a target receives a near miss, RDU strobe light blinks 2 times.

NOTE

Mobility kill and weapon kill are also indicated with 4-6 indicators.

b. **HIT.** If the target is hit, but not killed, RDU strobe light blinks 4-6 times.

NOTE

If panel gunnery training is used, the target system is auto-activated after 5 seconds. The indication stops and the system is operational.

c. **KILL.** If the target is hit and killed by a round or by a CGUN, RDU strobe light blinks continuously until the system is reset by the CGUN.

d. **Weapon Firing Sequence.** The front RDUs will flash when the coax weapon is being fired.

APPENDIX A
TROUBLESHOOTING CHECKLIST

If you have difficulty operating TWGSS, take the time to perform the following checks before you decide that there is something wrong with your system.

- Make sure that you have the vehicle master power, turret power, and TNB utility power ON.
- Make sure that the gun/turret drive switch is in MANUAL position.
- Check that main gun safe/armed handle is in ARMED position.
- Verify that the TDRS memory card is properly installed in control panel.
- Verify that the tank fire control malfunction lamp does NOT indicate a malfunction. If a malfunction is indicated, turn all power OFF.
- Verify that TWGSS malfunction indicator lights located on the vehicle interface unit, TBOS driver unit, and target computer unit are blinking. If malfunction light is on but NOT blinking or is OFF, perform troubleshooting.
- Check all cable connections to ensure that they are tight.
- Check BIT error list by selecting TE on the control panel and pressing ENTER. Correct errors or notify a trained TWGSS troubleshooter.
- Manually run BIT by selecting BT on the control panel and pressing ENTER. Correct errors or notify a trained TWGSS troubleshooter.
- Refer to TM 9-6920-709-12&P-1-2 for detailed trouble-shooting procedures.

APPENDIX B
LIST OF ABBREVIATIONS

AAR . . . . . After Action Review
BII . . . . . Basic Issue Items
BIT. . . . . Built-in Test
CCP. . . . . Computer Control Panel
CEU. . . . . Computer Electronics Unit
CGUN . . . . . Control Gun
CP . . . . . Control Panel
ELF . . . . . Eye-safe Laser Filter
FCS . . . . . Firing Control System
GAS. . . . . Gunner's Auxiliary Sight
GPS. . . . . Gunner's Primary Sight
HDDU . . . . . Hull Defilade Detector Unit
ITGS . . . . . Improved Tank Gunfire Simulator
LOS . . . . . Line-of-Sight
LP . . . . . Loader’s Panel
LRF . . . . . Laser Rangefinder
LTID. . . . . Laser Target Interface Device
MILES . . . . . Multiple Integrated Laser Engagement System
PGS. . . . . Precision Gunnery System
PMCS . . . . . Preventive Maintenance Checks and Services
RDU . . . . . Retro Detector Unit
RRU . . . . . Retro Reflector Unit
RSI . . . . . Remote System Interface
TBOS . . . . . Tracer, Burst, Obscuration Simulator
TCU. . . . . Target Computer Unit
TDRS . . . . . Training Data Retrieval System
TIS. . . . . Thermal Imaging System
TNB . . . . . Turret Networks Box
TPS . . . . . Turret Position Sensor
TSV . . . . . Thru-Sight Video
TU . . . . . Transceiver Unit

LIST OF ABBREVIATIONS (Con't)

TWGSS . . . . . Tank Weapon Gunnery Simulation System
VIU . . . . . Vehicle Interface Unit
VMU . . . . . Video Mixer Unit